

CLAIMS

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1. A harmonic motor comprising:

a) a first annular member having a longitudinal axis, wherein the first annular member lies in a plane perpendicular to the longitudinal axis, and wherein the first annular member is flexible along a direction which lies in the plane;

b) a second member substantially coaxially aligned with the first annular member and lying in the plane, wherein one of the first annular and second members is rotatable about the longitudinal axis, and wherein the other of the first annular and second members is nonrotatable about the longitudinal axis; and

c) means for flexing the first annular member into at least two spaced-apart points of contact with the second member and for sequentially flexing the first annular member to rotate the at least two points of contact about the longitudinal axis which rotates the rotatable one of the first annular and second members about the longitudinal axis, wherein the flexing means is nonrotatable about the longitudinal axis.

2. A harmonic motor comprising:

a) a first annular member having a longitudinal axis, wherein the first annular member is nonrotatable about the longitudinal axis and lies in a plane perpendicular to the longitudinal axis, and wherein the first annular member is flexible along a direction which lies in the plane;

b) a second annular member substantially coaxially aligned with the first annular member and lying in the plane, wherein the second annular member is rotatable about the longitudinal axis; and

c) means for flexing the first annular member into at least two spaced-apart points of contact with the second annular member and for sequentially flexing the first annular member to rotate the at least two points of contact about the longitudinal axis which rotates the second annular member about the

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longitudinal axis, wherein the flexing means is nonrotatable about the longitudinal axis.

3. The harmonic motor of claim 2, wherein the first annular member has an unflexed substantially circular shape, and wherein the second annular member has a substantially circular shape.
4. The harmonic motor of claim 3, wherein the first annular member is disposed circumferentially within the second annular member.
5. The harmonic motor of claim 4, wherein the first annular member has first gear teeth on its outer circumference, and wherein the second annular member has second gear teeth on its inner circumference.
6. The harmonic motor of claim 5, wherein the first annular member is a harmonic-gear-train flex-spline gear, and wherein the second annular member is a harmonic-gear-train outer gear.
7. The harmonic motor of claim 6, wherein the flexing means includes an array of spaced apart magnets disposed on the inner circumference of the flex-spline gear and a magnetic stator disposed inside and spaced apart from the array.
8. The harmonic motor of claim 6, wherein the flexing means includes an array of spaced-apart, piezoelectric members disposed on the inner circumference of the flex-spline gear.
9. The harmonic motor of claim 6, wherein the flexing means includes an array of spaced apart, magneto-restrictive members disposed on the inner circumference of the flex-spline gear.

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10. The harmonic motor of claim 2, wherein the flexing means includes an array of spaced apart magnets disposed on the inner perimeter of the first annular member and a magnetic stator disposed inside and spaced apart from the array.

11. The harmonic motor of claim 2, wherein the flexing means includes an array of spaced-apart, piezoelectric members disposed on the inner perimeter of the first annular member.

12. The harmonic motor of claim 2, wherein the flexing means includes an array of spaced apart, magneto-restrictive members disposed on the inner perimeter of the first annular member.

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13. A harmonic motor comprising:

- a) a harmonic-gear-train outer gear having a longitudinal axis;
- b) a harmonic-gear-train flex-spline gear having an inner circumference

and disposed inside the outer gear, wherein one of the outer and flex-spline
5 gears is rotatable about the longitudinal axis, and wherein the other of the outer and flex-spline gears is nonrotatable about the longitudinal axis; and

c) means for flexing the flex-spline gear into two substantially
diametrically opposite points of contact with the outer gear and for sequentially
flexing the flex-spline gear to rotate the at least two points of contact about the
10 longitudinal axis which rotates the rotatable one of the outer and flex-spline
gears about the longitudinal axis, wherein the flexing means is nonrotatable
about the longitudinal axis.

14. A harmonic motor comprising:

- a) a harmonic-gear-train outer gear rotatable about a longitudinal axis;
- b) a harmonic-gear-train flex-spline gear having an inner circumference,
disposed inside the outer gear, and nonrotatable about the longitudinal axis; and

5 ² c) means for flexing the flex-spline gear into two substantially
diametrically opposite points of contact with the outer gear and for sequentially
flexing the flex-spline gear to rotate the at least two points of contact about the
longitudinal axis which rotates the outer gear about the longitudinal axis in a
direction opposite the direction of rotation of the at least two points of contact,
10 wherein the flexing means is nonrotatable about the longitudinal axis.

15. A harmonic motor comprising:

- a) a harmonic-gear-train outer gear rotatable about a longitudinal axis;
- b) a harmonic-gear-train flex-spline gear having an inner circumference,
disposed inside the outer gear, and nonrotatable about the longitudinal axis;
- 5 c) an array of spaced apart magnets disposed on the inner circumference
of the flex-spline gear; and
- d) a nonrotatable magnetic stator disposed inside and spaced apart from
the array, wherein the magnetic stator is operable to magnetically repel and
attract substantially diametrically opposite ones of the magnets of the array in a
10 circumferentially sequential manner to create at least two substantially
diametrically opposite rotating points of contact of the flex-spline gear with the
outer gear to rotate the outer gear about the longitudinal axis.

16. A harmonic motor comprising:

- a) a harmonic-gear-train outer gear rotatable about a longitudinal axis;
- b) a harmonic-gear-train flex-spline gear having an inner circumference,
disposed inside the outer gear, and nonrotatable about the longitudinal axis; and
- 5 c) an array of spaced apart, piezoelectric members disposed on the inner
circumference of the flex-spline gear and operable to radially expand and
contract substantially diametrically opposite portions of the flex-spline gear in a
circumferentially sequential manner to create at least two substantially
diametrically opposite rotating points of contact of the flex-spline gear with the
10 outer gear to rotate the outer gear about the longitudinal axis.

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17. A harmonic motor comprising:

- a) a harmonic-gear-train outer gear rotatable about a longitudinal axis;
- b) a harmonic-gear-train flex-spline gear having an inner circumference, disposed inside the outer gear, and nonrotatable about the longitudinal axis; and
- 5 c) an array of spaced apart, magneto-restrictive members disposed on the inner circumference of the flex-spline gear and operable to radially expand and contract substantially diametrically opposite portions of the flex-spline gear in a circumferentially sequential manner to create at least two substantially diametrically opposite rotating points of contact of the flex-spline gear with the
- 10 outer gear to rotate the outer gear about the longitudinal axis.

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